## CLAIMS

What Is Claimed Is:

1. A molecular wire transistor comprising a pair of crossed wires, at least one of said wires comprising a doped semiconductor material, said pair of crossed wires forming a junction where one wire crosses another, a first semiconductor wire being of a first conductivity type and a second wire being provided with either Lewis acid functional groups or Lewis base functional groups to create a region of modulation doping of a second and opposite conductivity type in said junction.

2. The molecular wire transistor of Claim 1 wherein one of said wires comprises a semiconductor material and is nanoscopic in the direction of the shortest line between the two wires.

3. The molecular wire transistor of Claim 2 wherein the other wire is nanoscopic or larger in the direction of the shortest line between the two wires.

4. The molecular wire transistor of Claim 1 wherein one of said wires comprises N-doped semiconductor and the other wire comprises P-doped semiconductor.

5. The molecular wire transistor of Claim 4 wherein one wire of a given doping comprises emitter and collector regions and the other wire, being of the opposite doping, induces a base region by modulation doping on said wire containing said emitter and collector regions at said junction where said wires cross, said base region formed between said emitter and collector portions.

6. The molecular wire transistor of Claim 5 wherein a PNP bipolar transistor is formed.

7. The molecular wire transistor of Claim 5 wherein an NPN bipolar transistor is formed.

8. The molecular wire transistor of Claim 1 wherein one of said wires comprises doped semiconductor and the other wire comprises a metal.

9. The molecular wire transistor of Claim 8 wherein said doped semiconductor wire comprises source and drain regions and said metal wire inducing said gate by modulation doping on said doped semiconductor wire where said wires cross, between said source and drain regions, said functional groups on said metal wire comprising a first portion extending from said metal wire being electrically insulating and a second portion joined to said first portion comprising said Lewis acid or base functional group.

10. The molecular wire transistor of Claim 9 wherein an N-channel field effect transistor is formed.

11. The molecular wire transistor of Claim 9 wherein a P-channel field effect transistor is formed.

12. The molecular wire transistor of Claim 1 wherein both said semiconductor wires are provided with functional groups, one said wire being provided with Lewis acid functional groups and the other said wire being provided with Lewis base functional groups.

13. The molecular wire transistor of Claim 1 wherein either said Lewis acid functional groups or said Lewis base functional groups have two distinct oxidation-reduction states, a conductive state and a relatively insulating state with a large I-V hysteresis separating the two states, to form a state change transistor or a switch that is capable of being set by application of a voltage that is larger than the voltage at which the transistor operates.

14. The molecular wire transistor of Claim 13 wherein said state change is set, thereby forming a transistor.

15. The molecular wire transistor of Claim 13 wherein said state change is not set, thereby forming either an open or closed switch.

16. A method for fabricating a molecular wire transistor comprising a pair of crossed wires, at least one of said wires comprising a doped semiconductor material, said method comprising providing a first said wire having a first conductivity type, providing a second said wire with either Lewis acid functional groups or Lewis base functional groups to provide said second wire with a second conductivity type opposite to that of said first wire, and causing said pair of wires to cross, thereby forming a junction with modulation doping where one wire crosses another.

17. The method of Claim 16 wherein one of said wires comprises a semiconductor material and is nanoscopic in the direction of the shortest line between the two wires.

18. The method of Claim 17 wherein the other wire is nanoscopic or larger in the direction of the shortest line between the two wires.

19. The method of Claim 16 wherein one of said wires comprises N-doped semiconductor and the other wire comprises P-doped semiconductor.

20. The method of Claim 19 wherein one wire of a given doping induces a base region by modulation doping in said other wire around said junction, thereby defining emitter and collector regions on either side of said base region in said other wire.

21. The method of Claim 20 wherein a PNP bipolar transistor is formed.

22. The method of Claim 20 wherein an NPN bipolar transistor is formed.

23. The method of Claim 16 wherein one of said wires comprises doped semiconductor and the other wire comprises a metal.

24. The method of Claim 23 wherein said functional groups on said metal wire comprise a first portion that is electrically insulating and extends from said metal wire and a second portion joined to said first portion comprising said Lewis acid or base functional group and wherein said metal wire induces a gate region in said doped semiconductor wire around said junction, thereby defining source and drain regions on either side of said gate region in said other wire.

25. The method of Claim 24 wherein an N-channel field effect transistor is formed.

26. The method of Claim 24 wherein a P-channel field effect transistor is formed.

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27. The method of Claim 16 wherein both said semiconductor wires are provided with functional groups, one said wire being provided with Lewis acid functional groups and the other said wire being provided with Lewis base functional groups.

28. The method of Claim 16 wherein either said Lewis acid functional groups or said Lewis base functional groups have two distinct oxidation-reduction states, a conductive state and a relatively insulating state with a large I-V hysteresis separating the two states, to form a state change transistor or a switch that is capable of being set by application of a voltage that is larger than the voltage at which the transistor operates.

29. The method of Claim 28 wherein said state change is set, thereby forming a transistor.

30. The method of Claim 28 wherein said state change is not set, thereby forming either an open or closed switch.

31. A crossbar array of crossed-wire devices, each device comprising a junction formed by a pair of crossed wires where one wire crosses another, said junction having a functional dimension in nanometers, wherein at least one said junction in said crossbar array comprises a molecular wire transistor comprising a pair of crossed wires, at least one of said wires comprising a doped semiconductor material, said pair of crossed wires forming a junction where one wire crosses another, a first semiconductor wire being of a first conductivity type and a second wire being provided with either Lewis acid functional groups or Lewis base functional groups to create a region of modulation doping of a second and opposite conductivity type in said junction.

32. The crossbar array of Claim 31 wherein one of said wires comprises a semiconductor material and is nanoscopic in the direction of the shortest line between the two wires.

33. The crossbar array of Claim 32 wherein the other wire is nanoscopic or larger in the direction of the shortest line between the two wires.

34. The crossbar array of Claim 31 wherein one of said wires comprises N-doped semiconductor and the other wire comprises P-doped semiconductor.

35. The crossbar array of Claim 34 wherein one wire of a given doping comprises emitter and collector regions and the other wire, being of the opposite doping, induces a base region by modulation doping on said wire containing said emitter and col-

lector regions at said junction where said wires cross, said base region formed between said emitter and collector portions.

36. The crossbar array of Claim 35 wherein a PNP bipolar transistor is formed.

37. The crossbar array of Claim 35 wherein an NPN bipolar transistor is formed.

38. The crossbar array of Claim 31 wherein one of said wires comprises doped semiconductor and the other wire comprises a metal.

39. The crossbar array of Claim 38 wherein said doped semiconductor wire comprises source and drain regions and said metal wire inducing said gate by modulation doping on said doped semiconductor wire where said wires cross, between said source and drain regions, said functional groups on said metal wire comprising a first portion extending from said metal wire being electrically insulating and a second portion joined to said first portion comprising said Lewis acid or base functional group.

40. The crossbar array of Claim 39 wherein an N-channel field effect transistor is formed.

41. The crossbar array of Claim 39 wherein a P-channel field effect transistor is formed.

42. The crossbar array of Claim 31 wherein both said semiconductor wires are provided with functional groups, one said wire being provided with Lewis acid functional groups and the other said wire being provided with Lewis base functional groups.

43. The crossbar array of Claim 31 wherein either said Lewis acid functional groups or said Lewis base functional groups have two distinct oxidation-reduction states, a conductive state and a relatively insulating state with a large I-V hysteresis

separating the two states, to form a state change transistor or a switch that is capable of being set by application of a voltage that is larger than the voltage at which the transistor operates.

44. The crossbar array of Claim 43 wherein said state change is set, thereby forming a transistor.

45. The crossbar array of Claim 43 wherein said state change is not set, thereby forming either an open or closed switch.

46. The crossbar array of Claim 31 further including at least one connector species connecting said pair of crossed wires.